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IDENTIFICATION

FLOATING POINT NATURAL LOGARITHM, MU LOG5
704 FORTRAN II OR SAP PROGRAM
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PURPOSE

To compute the natural logarithm of (1+x), given a floating point argument x.

METHOD

For x = 0, ln(1+x) = 0

For $|x| \geq 1/16$, $\ln(1+x) = (I+\log_2 f)\ln 2$, where $x = f \cdot 2^I$ and $\log_2 f$ is the approximation given by Hastings:

$$\log_2 f = c_1\left(\frac{f-1}{f+1}\right) + c_3\left(\frac{f-1}{f+1}\right)^3 + c_5\left(\frac{f-1}{f+1}\right)^5$$

$$c_1 = 2.8853,9129,03$$
$$c_3 = .9614,7063,23$$
$$c_5 = .5989,7864,96$$

For $|x| < 1/16$, $\ln(1+x) = -\left[y + \frac{y^2}{2} + \frac{y^3}{3} + \frac{y^4}{4} + \frac{y^5}{5} + \cdots\right]$ where y = -x, and the summation is performed in fixed point arithmetic with maximum scaling on the y's. The summation is continued until the nth term is less than $|y^n| \cdot 2^{-27}$.

CALLING SEQUENCE

Enter with x in the accumulator. Control is returned with ln(1+x) in the accumlator. X and (1+x) are floating point numbers.

	SAP	FORTRAN
α	TSX LOG5,4	LOG5F(X)
α+1	return	

MULOG5 is available on the FORTRAN II system tape at this installation.

SPACE REQUIRED

94 words program at LOG5
6 words temporary at COMMON

```
        REM MU LOG5 MURA FLOATING POINT NATURAL LOGARITHM                MU   LOG5
LOG5    TZE 1,4                                                         LOG5  0001
        FAD ZERO            NORMALIZE ARGUMENT                          LOG5  0002
        STO COMMON                                                      LOG5  0003
        ANA MASK                                                        LOG5  0004
        SLW COMMON+5        SAVE CHARACTERISTIC                         LOG5  0005
        CLA COMMON                                                      LOG5  0006
        SSP                                                             LOG5  0007
        CAS P3              1/16                                        LOG5  0008
        TRA D                                                           LOG5  0009
        TRA D                                                           LOG5  0010
        LRS 35              SPLIT ARGUMENT                              LOG5  0011
        LLS 8                                                           LOG5  0012
        CHS                                                             LOG5  0013
        ADD H127            SET SCALING FACTOR                          LOG5  0014
        STA B                                                           LOG5  0015
        STZ COMMON+2        SUM=0                                       LOG5  0016
        CLA H1                                                          LOG5  0017
        STO COMMON+4                                                    LOG5  0018
        PXD 0,0                                                         LOG5  0019
        LLS 34                                                          LOG5  0020
        LDQ COMMON                                                      LOG5  0021
        LLS 0               SIGN TO AC                                  LOG5  0022
        CHS                                                             LOG5  0023
        STO COMMON          -(SF)X                                      LOG5  0024
A       STO COMMON+1        CURRENT TERM IN SUM                         LOG5  0025
        ADD COMMON+2                                                    LOG5  0026
        STO COMMON+2        SUM=SUM+TERM                                LOG5  0027
        CLA COMMON+4                                                    LOG5  0028
        STO COMMON+3        N                                           LOG5  0029
        ADD H1                                                          LOG5  0030
        STO COMMON+4        N+1                                         LOG5  0031
        LDQ COMMON+1        NTH TERM                                    LOG5  0032
        MPY COMMON+3                                                    LOG5  0033
        DVH COMMON+4                                                    LOG5  0034
        MPY COMMON                                                      LOG5  0035
B       ARS **              DIVIDE BY SCALING FACTOR                    LOG5  0036
        TNZ A               CONVERGENCE TEST                            LOG5  0037
        LDQ COMMON+2                                                    LOG5  0038
        LLS 1                                                           LOG5  0039
        LDQ COMMON+2                                                    LOG5  0040
        TZE *+2                                                         LOG5  0041
        LRS 1                                                           LOG5  0042
        LLS 28                                                          LOG5  0043
        ACL COMMON+5                                                    LOG5  0044
        CHS                                                             LOG5  0045
        FAD ZERO                                                        LOG5  0046
        TRA 1,4                                                         LOG5  0047
D       CLA COMMON                                                      LOG5  0048
        FAD FPONE                                                       LOG5  0049
        TZE 1,4                                                         LOG5  0050
        SSP                                                             LOG5  0051
        LRS 27                                                          LOG5  0052
        STQ COMMON                                                      LOG5  0053
        ALS 19                                                          LOG5  0054
        ORA P1                                                          LOG5  0055
        FSB D1                                                          LOG5  0056
        STO COMMON+1                                                    LOG5  0057
        CLA COMMON                                                      LOG5  0058
        LRS 8                                                           LOG5  0059
```

```
        ORA P2                                                  LOG5  0060
        FAD D2                                                  LOG5  0061
        STO COMMON                                              LOG5  0062
        FSB D3                                                  LOG5  0063
        FDH COMMON                                              LOG5  0064
        STQ COMMON                                              LOG5  0065
        FMP COMMON                                              LOG5  0066
        STO COMMON+2                                            LOG5  0067
        LDQ C5                                                  LOG5  0068
        FMP COMMON+2                                            LOG5  0069
        FAD C3                                                  LOG5  0070
        LRS 35                                                  LOG5  0071
        FMP COMMON+2                                            LOG5  0072
        FAD C1                                                  LOG5  0073
        LRS 35                                                  LOG5  0074
        FMP COMMON                                              LOG5  0075
        FAD COMMON+1                                            LOG5  0076
        LRS 35                                                  LOG5  0077
        FMP D4                                                  LOG5  0078
        TRA 1,4                                                 LOG5  0079
ZERO    HTR 0                                                   LOG5  0080
MASK    OCT 377000000000                                        LOG5  0081
FPONE   OCT 201400000000                                        LOG5  0082
C1      DEC 2.88539129030E00                                    LOG5  0083
C3      DEC 9.61470632300E-01                                   LOG5  0084
C5      DEC 5.98978649600E-01                                   LOG5  0085
D1      DEC 1.28500000000E02                                    LOG5  0086
D2      DEC 7.07106781187E-01                                   LOG5  0087
D3      DEC 1.41421356237E00                                    LOG5  0088
D4      DEC 6.93147180560E-01                                   LOG5  0089
P       OCT 210000000000                                        LOG5  0090
P2      OCT 200000000000                                        LOG5  0091
P3      OCT 175400000000                                        LOG5  0092
H1      HTR 1                                                   LOG5  0093
H127    HTR 127                                                 LOG5  0094
        END LOG5                                                LOG5  0095
```